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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS & INTERFERENCES

Serial No.: 10/600,605

Group Art Unit: 1745

Inventors: Christie et al.

Filed: June 23, 2003

Title: STORAGE SYSTEM AND METHOD FOR SUPPLYING HYDROGEN TO A POLYMER MEMBRANE FUEL CELL

Examiner: R. Alejandro

APPEAL BRIEF

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This is a brief in support of an appeal from the decision of the Examiner dated February 2, 2006. A notice of appeal was filed March 14, 2006.

TABLE OF CONTENTS

I. REAL PARTY IN INTEREST

The real party in interest is Praxair Technology, Inc., the assignee of record.

II. RELATED APPEALS AND INTERFERENCES

There are no related appeals and interferences that have a direct affect or are directly affected by or have a bearing on the Board's decision in the pending appeal.

III. STATUS OF CLAIMS

Claims 1-10 are pending and stand rejected. Claims 1 and 7 were amended under Rule 111 by an amendment dated December 28, 2005, which has been entered by the Examiner.

IV. STATUS OF AMENDMENTS

All amendments that have been filed in this case have been entered and there are no outstanding amendments.

V. SUMMARY OF CLAIMED SUBJECT MATTER

The present invention as recited in claim 1 is for a hydrogen storage system for supplying hydrogen to a fuel cell employing a polymer membrane. The fuel cell consumes part of the hydrogen to power a load in accordance with a predetermined electrical power requirement and a further part of the hydrogen to operate on a scheduled basis, when not powering the load, to maintain the polymer membrane in a hydrated condition. As indicated in Paragraph 3 of the Background of the Invention, fuel cells used to supply back-up power and for other uses require a sufficient amount of hydrogen to be stored to allow the fuel cell to supply specific amount of electrical energy for the particular load involved. This may be specified, for example, 5 kilowatts of power for 8 hours. The storage of hydrogen for fuel cells that utilize polymer membranes is complicated by the fact that the fuel cell must be powered up in accordance with a schedule, for instance, every month for 15 minutes, in order to ensure that the membrane remains hydrated. The problems inherent in this is that such scheduled maintenance operation of the fuel cell will consume hydrogen that otherwise must be on hand to ensure the fuel cell will be able to meet its intended power requirements. As indicated in Paragraph 4, the continuing requirement to recharge a bulk hydrogen supply becomes a logistically complex, if not expensive proposition.

In order to solve such problems, hydrogen storage systems: 1 illustrated in Figure 1; 1' illustrated in Figure 2 and 1" illustrated in Figure 3 are provided. A main hydrogen storage site is provided by first and second banks 10 and 12 of compressed gas cylinders 14 that are connected to one another as shown in Figure 1 to generate the predetermined electrical power requirement. In Figure 2, the main hydrogen storage site is formed by first and second hydrogen storage banks 70 and 72 of compressed gas cylinders 74. In Figure 3, the main hydrogen storage site is provided by a composite carbon-fiber wrapped composite cylinder 80 . An auxiliary hydrogen storage site is also provided that can be formed from a single compressed gas cylinder 16 (in all figures) to contain the further part of the

hydrogen to allow the fuel cell to operate on a scheduled basis to maintain the polymer membrane in a hydrated condition.

A manifold is connected to the main hydrogen storage site. In Figure 1 manifold 18 is connected to the main hydrogen storage site 10, 12. In Figure 2, manifold 18' is connected to main hydrogen storage site 70, 72 and in Figure 3, manifold 18" is connected to the main hydrogen storage site 80. The manifold 18 has an outlet 20 to the fuel cell, the manifold 18' has an outlet 78 to the fuel cell and the manifold 18" has an outlet 104 to the fuel cell.

Each of the manifolds 18, 18' and 18" is configured to allow the auxiliary hydrogen storage site, that in the figures is provided by a single compressed gas cylinder 16, to be renewed independently of the main hydrogen storage site 10, 12; 70, 72; and 80, respectively. In Figure 1 this is done by providing a line 22 with a line purge valve 26 to allow line 22 to be purged upon removal of compressed gas cylinder 16. A shut-off valve 32 allows the line to be closed. The compressed gas cylinder 16 can be removed from manifold 18 by simply uncoupling any one of a number of known pressure fittings. In Figure 2, a line purge valve 60 is provided along with a shut-off valve 62. In Figure 3, a line purge valve 88 and a shut-off valve 62 is provided for such purposes.

Each of the manifolds 18, 18' and 18" is also provided with a flow control network to allow the fuel cell to draw hydrogen from the auxiliary hydrogen storage site, compressed gas cylinder 16, to maintain the membrane in a hydrated condition without utilizing the hydrogen from the main storage site. For such purpose, in Figure 1, manifold 18 is provided with first, second and third pressure regulators 38, 40 and 42 which are interposed between a junction 44 and an outlet pressure regulator 46. First pressure regulator 38 is set at the highest pressure so that hydrogen will first draw from the auxiliary hydrogen storage site provided by compressed gas cylinder 16. Check valves 50 and 56 are provided in lines 27 and 24 connected to storage banks 12 and 10 to prevent utilization of the hydrogen from the main hydrogen storage site when hydrogen is being withdrawn from the auxiliary storage site 26. This particular configuration that is utilized in connection with manifold 18 is specifically recited in Claim 2. It is to be noted

that in Figure 2, manifold 18' is provided with a first pressure regulator 62 set at a higher pressure than a second pressure regulator 65 and check valves 66 and 68. In Figure 3, manifold 18", first and second pressure regulators 94 and 98 are provided together with check valves for such purposes.

As set forth in claim 3, the main hydrogen storage site can consist of two banks, compressed gas cylinders, namely, 10 and 12 of Figure 1 and 70 and 72 of Figure 2. Additionally, the auxiliary hydrogen storage tank can be a single compressed gas cylinder 16.

As indicated in claim 4, the pressure regulators can be first, second and third pressure regulators, namely, pressure regulators 38, 40 and 42 associated with a single compressed gas cylinder 16, the banks of compressed gas cylinders 10 and the other of the banks of compressed gas cylinders 12, respectively. A first pressure regulator 38 is set at a higher pressure than the second pressure regulator 40 which is in turn set at a higher pressure than the third pressure regulator 42 such that the hydrogen is drawn from the single compressed gas cylinder 16, the one of the two banks of compressed gas cylinders 10 and then the other of the two banks of compressed gas cylinders 12. In this regard, see also Paragraph 21.

With respect to claim 5, two banks of compressed gas cylinders 70 and 72 can be connected to a manifold 18' to commonly feed the manifold 18' with hydrogen. The pressure regulators can be first and second pressure regulators 64 and 65, respectively, associated with a single compressed gas cylinder 16 and the two banks of compressed gas cylinders 70 and 72, respectively. The first pressure regulator 64 is set at a higher pressure than the second pressure regulator 65 such that the hydrogen is first drawn from the single compressed gas cylinder 16 to the outlet 78. In this regard, see Paragraph 26.

Claim 6 that is dependent upon claim 2 and calls for the main hydrogen storage bank to be a composite, carbon-fiber wrapped compressed gas cylinder 80. The auxiliary hydrogen storage bank is a single compressed gas cylinder 16. The pressure regulators are a first pressure regulator 94 associated with the single compressed gas cylinder. The second pressure regulators 96 and 98 are associated

with the composite, carbon-fiber wrapped compressed gas cylinder 80. An outlet pressure regulator 102 is provided to adjust the pressure of the hydrogen of the outlet manifold 18". The second and third pressure regulators are situated in an in-line relationship to regulate pressure of the hydrogen supply from the composite, carbon-fiber wrapped compressed gas cylinder 80 to a level below that regulated by a first pressure regulator 94 such that the hydrogen is first drawn from the single compressed gas cylinder 16 to the outlet 104.

Claim 7 relates to a method of supplying hydrogen to a fuel cell employing a polymer membrane. The fuel cell consumes part of the hydrogen to power load in accordance with a predetermined electrical power requirement and a further part of the hydrogen to operate on a scheduled basis when not powering a load to maintain the polymer membrane in a hydrated condition.

Part of the hydrogen that is used to generate the electricity that power the load supply from a main hydrogen storage site, namely banks of cylinders 10 and 12 in Figure 1, banks of cylinders 70 and 72 in Figure 2 and the carbon-fiber wrapped compressed gas cylinder 80 in Figure 3.

The further part of the hydrogen is supplied to the fuel cell from a compressed gas cylinder 16 on a scheduled basis. In this regard, as indicated in Paragraph 18, the fuel cell itself is activated for the foregoing purposes by known automated means to supply power beneath the predetermined electrical power requirement or for maintenance purposes on the scheduled basis. Furthermore, in Paragraph 22 it is indicated that assuming there is no requirement for hydrogen from the main storage site, scheduled operation of fuel cell will cause a solenoid valve within the fuel cell that is not illustrated to open and the fuel cell will first draw hydrogen from the compressed gas cylinder 16. Furthermore, as indicated in Paragraph 22, periodically, the auxiliary storage site 16, namely the compressed gas cylinders 16 can be renewed that it remains charged with the further part of the hydrogen to allow the fuel cell to operate on the scheduled basis without withdrawing hydrogen from the main hydrogen storage site 10 and 12.

As set forth in claim 8, the hydrogen is delivered from both the main hydrogen storage site and the auxiliary hydrogen storage site to a manifold 18

having an outlet 20 to the fuel cell. The manifold 18 has check valves 50 and 56 to prevent the flow of hydrogen from the auxiliary hydrogen site 16 to the main hydrogen storage site 10 and 12 and from the main hydrogen storage site 10 and 12 to the auxiliary hydrogen storage site 16 by provision of check valves 50 and 56. The hydrogen from the auxiliary hydrogen storage site is delivered to manifold 18 at a higher pressure than the main hydrogen storage site provided by 10 and 12 by provision of check valves 38, 40 and 42 in which check valve 38 is set to a higher pressure than check valves 40 and 42.

As set forth in claim 9, the auxiliary hydrogen storage site can be a single compressed gas cylinder 80 which is a carbon fiber-wrapped high pressure gas cylinder and the auxiliary hydrogen storage site 16 can be removed by periodically replacing the single compressed gas cylinder 16.

As recited in claim 10, the auxiliary hydrogen storage site is a single compressed gas cylinder 16 that is renewed by periodically disconnecting the single hydrogen gas storage tank from the manifold and replacing the single compressed gas cylinder 16. As set forth in Paragraph 27, a shut-off valve 90 is provided for such purposes within line 82 of manifold 18".

VI. <u>GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL</u>

The following are concise statements of each ground of rejection presented for review:

i.) whether claims 1-5 and 7-10 are unpatentable over 35 U.S.C. §102(e) as being anticipated by Shabana et al. 2004/0018632 A1 as being anticipated.

ii.) whether claims 2 and 8 are unpatentable over Shabana et al. 2004/0018632 as applied to claims 1 and 7 above and in further view of Japanese patent publication JP 04-115470.

iii.) whether claim 6 is unpatentable under 35 U.S.C. §103(a) as being unpatentable over (a) Shabana et al. 2004/0018632 and/or (b) Shabana et al. 2004/0018632 in further in view of Japanese patent publication JP 04-115470 as applied to claim 2 above and further in view of McCallister 6,756,140 (A) anticipation of claims 1-5 and 7-10 under 35 U.S.C. §102(e).

VII. ARGUMENTS

A) Claims 1-5 and 7-10 are not anticipated by Shabana et al. 2004/0018632 A1 ("Shabana").

A-1) Rejection of claim 1

Claim 1 recites in relevant part:

a main hydrogen storage site;

an auxiliary hydrogen storage site;

a manifold connected to the main hydrogen storage site and the auxiliary hydrogen storage site having an outlet; the manifold being configured to allow the auxiliary hydrogen storage site to be renewed independently of the main hydrogen storage site; and

the manifold having a flow control network to allow the fuel cell to withdraw hydrogen from the auxiliary hydrogen storage site to maintain a polymer membrane in a hydrated condition without utilization of the hydrogen from the main hydrogen storage site.

With respect to claim 1, Shabana does not disclose a main hydrogen storage site, an auxiliary hydrogen storage site or a manifold having a flow control network to allow a fuel cell to draw hydrogen from the auxiliary hydrogen storage site to maintain a polymer membrane in a hydrated condition without utilization of the hydrogen from the main hydrogen storage site and consequently Shabana does not anticipate Claim 1.

Shabana discloses a hydrogen processing unit 30 which is configured to selectively receive hydrogen gas from, either a compressed gas source, a liquid hydrogen source or a solid hydrogen source, but not all at once. Rather, hydrogen processing unit 30 is configured to be flexible to utilize hydrogen from any one of such sources. As indicated in paragraph 24 thereof, "Therefore, for example the hydrogen processing unit 30 may be installed as part of a fuel cell system 10 in a vehicle. As developments occur in the design, manufacturing and use of different forms of hydrogen storage media, the originally installed hydrogen storage media may be removed from the vehicle and replaced by a different type of hydrogen storage media which includes hydrogen stored in a different state". Thus, it is

apparent that Shabana envisions that compressed gas contained in containers 40 and 42 would be used. However, if a hydrogen source utilizing hydrates become practical, the same would replace the compressed gas as a source of hydrogen. In this regard, in the description of Figure 1 of Shabana, a common manifold 44 carries hydrogen gas from storage tanks 40 and 42 to the hydrogen processing unit 30, wherein a hydrogen pressure regulator 36, such as a throttle valve, drops the pressure to a desired stacked pressure such as 10 bars to provide 1.3 to 3 bars to the hydrogen fuel stacks. Heat exchanger 32 in hydrogen processing unit 30 heats the gas to the desired stack temperature. Note here that the compressed hydrogen gas would flow from both containers at once until both were depleted. The same is true with respect to Figure 2 in which a fuel cell system 110 is shown in which three compressed gas hydrogen storage tanks 112, 114 and 116 are connected to a common manifold 118 for delivering to hydrogen processing unit 30. Hydrogen would be drawn simultaneously from all three storage tanks and not just one of the storage tanks for maintenance purposes as recited in claim 1. There are no check valves and the like such that one of the tanks could be renewed independently from the other of the tanks and hence, none would constitute an auxiliary hydrogen storage site. Also, it is to be noted that manifold 118 has no flow control network to allow the fuel cell to draw hydrogen from just one of the tanks. All three tanks feed the manifold 118 at once.

<u>A-2) Rejection of Claim 7</u>

Claim 7 recites in relevant part:

supplying the part of the hydrogen to the fuel cell to generate electricity to power the load from a main hydrogen storage site;

supplying the further part of the hydrogen to the fuel cell on the scheduled basis from an auxiliary hydrogen storage site; and

periodically renewing the auxiliary hydrogen storage site so that it remains charged with the further part of the hydrogen to allow the fuel cell to operate on the scheduled basis without drawing hydrogen from the main hydrogen storage site.

Shabana does not also anticipate claim 7 because, again, Shabana is configured to supply hydrogen simultaneously from all sites and hence, it does not have a provision for supplying the part of the hydrogen fuel cell that is used to generate electricity to power the load from a main hydrogen storage site and to supply the further part of the hydrogen to the fuel cell on a scheduled basis from the auxiliary hydrogen storage. Furthermore, it does not disclose nor is it at all operable to provide for periodically renewing of auxiliary hydrogen storage site so that it remains changed with the further part of the hydrogen that is used for maintenance purposes. For Example, no check valves are disclosed that would allow the removal of compressed gas hydrogen storage tank 112 while drawing hydrogen from compressed hydrogen storage tanks 114 and 116.

A-3) Rejection of claim 2

Claim 2 calls for the flow control network to be provided with pressure regulators configured such that hydrogen from the auxiliary storage site is delivered to the outlet of the network before the hydrogen stored in the main hydrogen storage tank and check valves are also provided to prevent the flow of hydrogen between the main and auxiliary hydrogen storage site. In Shabana, the pressure regulator 36 mentioned above is fed by all tanks simultaneously to maintain the pressure suitable for the fuel cell stack. Further, there is no provision for check valves in the flow control network so that the flow of hydrogen is prevented between tanks. As indicated above, all tanks simultaneously feed the fuel cell stacks.

A-4) Rejection of claims 4 and 5

Claim 4, calls for first, second and third regulators associated with the single compressed gas cylinder and the two banks of compressed gas cylinders that are set at successively high pressures so that the hydrogen is drawn from the single compressed gas cylinder that forms the auxiliary hydrogen storage site and then the one of the two banks and thereafter the other of the two banks of compressed gas cylinders. Claim 5 calls for first and second pressure regulators

associated with the single compressed gas cylinder and the two banks of compressed gas cylinders that are set at successively higher pressures so that the hydrogen is first drawn from the single compressed gas cylinder. There simply is no provision in Shabana for multiple pressure regulators as recited in claims 4 and 5 so that the hydrogen is drawn from a single gas cylinder serving the auxiliary site and then from a cylinder or cylinders serving the main hydrogen storage site.

A-5) Rejection of Claim 8

Claim 8, that is dependent on claim 7, calls for the hydrogen to be delivered from both the main hydrogen storage site and auxiliary hydrogen storage site to a manifold having an outlet to a fuel cell. The manifold has check valves to prevent the flow of hydrogen from the auxiliary hydrogen storage site to the main hydrogen storage site and vice-versa and the hydrogen is delivered to the manifold at a higher pressure than that of the main hydrogen storage site so that hydrogen will be first drawn from the auxiliary hydrogen storage site. Again, as pointed out above, Shabana does not have provision for supplying hydrogen from a main hydrogen storage site and auxiliary hydrogen storage site, let alone supplying the same at different pressures to ensure that the hydrogen is first delivered from the auxiliary hydrogen storage site.

A-6) Rejection of Claims 9 and 10

Claim 9 calls for the single compressed gas cylinder to be periodically replaced to renew the auxiliary hydrogen storage site. Claim 10 calls for the single compressed gas cylinder to be periodically disconnected from the manifold and replaced to renew the auxiliary hydrogen storage site. Again, Shabana does not have any provision for periodically replacing a single compressed gas cylinder. For example, with respect to the compressed gas cylinders shown in Shabana, hydrogen would be drawn simultaneously from all three storage tanks and not just one of the storage tanks for maintenance purposes and further, there are no check valves and the like such that one of the tanks could be renewed independently from the other of the tanks.

<u>B) Claims 2 and 8 are patentable over Shabana and in further view of Japanese public application JP 04-115470 ("the JP publication").</u>

<u>B-1) Rejection of Claim 2</u>

Claim 2 recites, in relevant part, that the flow control network utilized in claim 1 allows the fuel cell to draw hydrogen from the auxiliary hydrogen storage tank without utilization of the hydrogen from the main storage tank by provision pressure regulators configured such that hydrogen from the auxiliary hydrogen storage site is delivered to the outlet before the hydrogen stored in the main hydrogen storage site and by check valves that prevent the flow of hydrogen between the main and auxiliary hydrogen storage site.

The JP publication does not disclose any structural feature that would allow hydrogen to be drawn from one site without utilization of the hydrogen from another site by provision of pressure regulators and check valves. Applicants submit that the JP publication, applied against the claims, discloses a system for storing the hydrogen to be used in generating electrical power at a time of a power shortage. Surplus power from power regulation units 3a and 3b is used to electrolyze water fed out of the storage tanks 15a and 15b by pumps 16a and 16b. The water is made into steam and then electrolyzed within units 4a and 4b to generate hydrogen to be stored within hydrogen storage tanks 24a and 24b. It is to be noted that elements 25a and 25b are given the same symbol as pumps 16 in Figure 1 and therefore, it is unlikely that they are pressure regulators or indicators as alleged by the Examiner. In any case, at the time of a power shortage, the hydrogen is supplied back to units 4a and 4b, which are oxygen, hydrogen, electro-chemical reactors (misnumbered as 14 with respect to Figure 1 in the Abstract) to generate power.

It would appear that there exists a connection between the hydrogen storage tanks 24a and 24b but no connection with both of the tanks to feed either unit 4a or 4b. As such, while quite possibly, the hydrogen storage tanks 24a and 24b can feed each other, hydrogen storage tank 24a solely feeds unit 4a and hydrogen storage tank 24b solely feeds unit 4b.

B-2) Rejection of Claim 8

The Japanese publication adds nothing here that would render claim 8 unpatentable in that as also pointed out previously claim 8 specifically provides for delivering hydrogen from an auxiliary storage site and then the main hydrogen storage site to a fuel cell by provision of pressure regulators and check valves. In the Japanese publication, at the time of a power shortage, the hydrogen is supplied back to units 4a and 4b, simultaneously, which are oxygen, hydrogen, electro-chemical reactors to generate power and not from one storage site and then from the other storage site.

C) Claim 6 is not rendered unpatentable over Shabana and/or Shabana further in view of JP 04-115470 ("the JP.publication") and in further in view of McCallister 6,756,140 ("McCallister")

Claim 6 recites in relevant part that the main hydrogen storage site is a composite, carbon-fiber wrapped compressed gas cylinder, the auxiliary hydrogen storage bank is a single compressed gas cylinder and that the pressure regulators constitute a first pressure regulator associated with the single compressed gas cylinder, second and third pressure regulators associated with the composite carbon-fiber wrapped compressed gas cylinder and an outlet pressure regulator to adjust the outlet pressure of the hydrogen at the outlet of the manifold. The second and third pressure regulators are situated in an in-line relationship to regulate pressure of the hydrogen supplied by the composite carbon-fiber wrapped compressed gas cylinder to a level below that regulated by the first pressure regulator such that hydrogen is first drawn from the single compressed gas cylinder to the outlet.

As stated previously, neither the Shabana or the Japanese publication disclose a series of pressure regulators in-line that would be set at different levels to allow gas to be drawn from one auxiliary source and not some other source such as a main hydrogen storage bank.

McCallister adds nothing that would render claim 6 unpatentable. While McCallister discloses a fiber reinforced composite cylindrical tanks that utilizes carbon fiber, this tank is not connected in a flow control network having pressure regulators configured such that hydrogen from an auxiliary hydrogen storage site is delivered before the hydrogen stored from the carbon fiber-wrapped cylinder by provision of second and third pressure regulators at a level below that regulated by a first pressure regulated associated with the auxiliary hydrogen storage tank such that hydrogen is first drawn from the single compressed gas cylinder to an outlet.

VIII. CONCLUSION

In conclusion, Applicants request reconsideration and reversal of the rejections made in this case and allowance of all pending claims.

Respectfully submitted,

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EVIDENCE APPENDIX

None.

CLAIMS APPENDIX

1. A hydrogen storage system for supplying hydrogen to a fuel cell employing a polymer membrane, the fuel cell consuming part of the hydrogen to power a load in accordance with a predetermined electrical power requirement and a further part of the hydrogen to operate on a scheduled basis when not powering the load to maintain the polymer membrane in a hydrated condition, said system comprising:

a main hydrogen storage site to contain the part of the hydrogen for the fuel cell to generate the predetermined electrical power requirement;

an auxiliary hydrogen storage site to contain the further part of the hydrogen to allow said fuel cell to operate on a scheduled basis to maintain the polymer membrane in the hydrated condition;

a manifold connected to the main hydrogen storage site and the auxiliary hydrogen storage site and having an outlet to deliver the hydrogen to the fuel cell;

the manifold being configured to allow the auxiliary hydrogen storage site to be renewed independently of the main hydrogen storage site; and

the manifold having a flow control network to allow said fuel cell to draw the hydrogen from the auxiliary hydrogen storage site to maintain the polymer membrane in the hydrated condition without utilization of the hydrogen from the main hydrogen storage site.

2. The hydrogen storage system of claim 1, wherein the flow control network has pressure regulators configured such that the hydrogen from the auxiliary hydrogen storage site is delivered to the outlet before the hydrogen stored in the main hydrogen storage site and check valves to prevent the flow of hydrogen between the main and auxiliary hydrogen storage site.

3. The hydrogen storage system of claim 2, wherein:

said main hydrogen storage site consists of two banks of compressed gas cylinders; and

said auxiliary hydrogen storage site is a single compressed gas cylinder.

4. The hydrogen storage system of claim 3, wherein:

the pressure regulators are first, second, and third regulators associated with said single compressed gas cylinder and one and the other of the two banks of the compressed gas cylinders and an outlet pressure regulator to adjust outlet pressure of the hydrogen at the outlet of the manifold; and

the first pressure regulator is set at a higher pressure than the second pressure regulator which is in turn set at a higher pressure than the third pressure regulator, such that the hydrogen is first drawn from the single compressed gas cylinder, the one of the two banks of compressed gas cylinders and then the other of the two banks of compressed gas cylinders.

5. The hydrogen storage system of claim 3, wherein:

the two banks of compressed gas cylinders are connected to the manifold to commonly feed the manifold with hydrogen; and

the pressure regulators are first and second pressure regulators associated with the single compressed gas cylinder and the two banks of compressed gas cylinders, respectively; and the first pressure regulator is set at a higher pressure than the second pressure regulator such that the hydrogen is first drawn from the single compressed gas cylinder to the outlet.

6. The hydrogen storage system of claim 2, wherein:

the main hydrogen storage site is a composite, carbon-fiber wrapped compressed gas cylinder;

the auxiliary hydrogen storage site of the hydrogen storage bank is a single compressed gas cylinder; and

the pressure regulators are a first pressure regulator associated with the single compressed gas cylinder, second and third second pressure regulators associated with the composite, carbon-fiber wrapped compressed gas cylinder, and an outlet pressure regulator to adjust outlet pressure of the hydrogen at the outlet of the manifold;

the second and third pressure regulators being situated in an in line relationship to regulate pressure of the hydrogen supplied from the composite, carbon-fiber wrapped compressed gas cylinder to a level below that regulated by the first pressure regulator such that the hydrogen is first drawn from the single compressed gas cylinder to the outlet.

7. A method of supplying hydrogen to fuel cell employing a polymer membrane, the fuel cell consuming part of the hydrogen to power a load in accordance with a predetermined electrical power requirement and a further part of the hydrogen to operate on a scheduled basis when not powering the load to maintain the polymer membrane in a hydrated condition, said method comprising:

supplying the part of the hydrogen to the fuel cell to generate electricity to power the load from a main hydrogen storage site;

supplying the further part of the hydrogen to the fuel cell on the scheduled basis from an auxiliary hydrogen storage site; and

periodically renewing the auxiliary hydrogen storage site so that it remains charged with the further part of the hydrogen to allow the fuel cell to operate on the scheduled basis without drawing hydrogen from the main hydrogen storage site.

8. The method of claim 7, wherein:

the hydrogen is delivered from both the main hydrogen storage site and the auxiliary hydrogen storage site to a manifold having an outlet to the fuel cell;

the manifold has check valves to prevent the flow of hydrogen from the auxiliary hydrogen storage site to the main hydrogen storage site and vice-versa;

the hydrogen from the auxiliary hydrogen storage site is delivered to the manifold at a higher pressure than that of the main hydrogen storage site such that the hydrogen will be first drawn from the auxiliary hydrogen storage site.

9. The method of claim 7, wherein the auxiliary hydrogen storage site is a single compressed gas cylinder and the auxiliary hydrogen storage site is renewed by periodically replacing the single compressed gas cylinder.

10. The method of claim 8, wherein the auxiliary hydrogen storage site is a single compressed gas cylinder and the auxiliary hydrogen storage site is renewed by periodically disconnecting the single compressed gas cylinder from the manifold and replacing the single compressed gas cylinder.

RELATED PROCEEDINGS APPENDIX

None.